

RESEARCH ARTICLE

SEASONAL INCIDENCE OF APHID AND THRIPS IN RELATION TO WEATHER PARAMETERS ON GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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Abstract: The current study was undertaken on Seasonal incidence and management of major insect-pests of groundnut during 07 July 2022 to 20 October 2022 at the experimental area Research cum Instructional Farm at RMD, CARS, Ambikapur (C. G.). The groundnut aphid, and thrips populations were found in field. Aphid and thrips population the first emergence of the pest incidence was recorded during second week of August (32nd SMW) with (0.73 aphid three leaves /plant and 0.27 thrips/top bud leaves) . The population of aphid and thrips reached to its peak in 36th SMW (05 Sep.–11 Sep.) with 8.62 aphid three leaves /plant and 4.80 thrips/top bud leaves in first week of September. The correlation between aphid population and meteorological parameters, the population of aphids had a positive relationship with temperature (maximum and minimum) and relative humidity (morning) while there is a negative association between evening relative humidity and rainfall. The correlation was significant with minimum temperature.

Keywords: Aphid, Groundnut, Thrips, Weather parameters.

INTRODUCTION

The groundnut (*Arachis hypogaea* L.), a tetrafoliate leguminous crop native to South America, is in the family Fabaceae, and the genus *Arachis*. Groundnut is considered to be the fourth-most significant oilseed crop globally due to its excellent edible oil content. It contains edible oil (48–50%), protein (26–28%), calcium (26 milligrams), iron (2.0 mg), and phosphorus (402 mg) as well as vitamins such as niacin (17.2 mg), thiamine (1.14 mg), riboflavin (0.13 mg) per 100 gram of groundnut kernel (Padgham *et al.* 1990). Oleic acid and linoleic acid are the primary fatty acid components of groundnut oil, accounting for 65–85% of its overall composition (Mercer *et al.*, 1990).

The cultivation of groundnuts in India is predominantly centred in the states of Gujarat, Karnataka, Andhra Pradesh (AP), Telangana, Tamil Nadu (TN), Maharashtra (MH), and Rajasthan. Groundnut cultivation covers 49.50 lakh hectares in India, with an annual yield of 83.00 lakh metric tonnes and a productivity of 1688 kg/ha. Chhattisgarh is an emerging state in groundnut production with a cultivated area of 49.97 thousand hectares, a production of 41.82 thousand tonnes annually, and a productivity of 1635 kg/ha.

The nymphal and adult stages of the aphid extract the sap of the plant from young shoots, and leaves leading to mottled leaves with chlorotic green markings and impeding the growth of the

plants. Additionally, it transmits several viral diseases *viz.*, mottle virus (PeMoV), rosette virus (GRV), and stripe virus (PStV) of groundnut (Khan and Hussain, 1965). Thrips have been identified as vectors for the transmission of groundnut bud necrosis virus, while their primary mode of feeding involves the laceration and subsequent sap extraction from leaves.

MATERIALS AND METHODS

Throughout the duration of the trial, the application of insecticides was not employed. Regular surveillance was conducted on the groundnut crop to monitor the seasonal occurrence patterns for sucking insect-pests. This surveillance had been carried out on a weekly basis, starting from the emergence of the crop and continuing until the harvest.

Field layout and design

To evaluate the seasonal incidence of the major insect-pests of groundnut crop, the cultivation of groundnut var. 44 begun on July 7th, 2022 with six distinct blocks that were each 4.0 m length, and 1.5 m width. Row-to-row spacing is kept at 30 cm, while plant-to-plant spacing is kept at 10 cm. Varieties were used TG-82, TG-83, TG-86, TG-87, TG-88, TG-89, TAG-24, JL-776.

Methodology of observation

Weekly populations of aphid and thrips were counted in the early morning hours. This monitoring was carried out on five randomly chosen and labeled

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plants in each block, beginning with pest commencement and ending with crop harvest.

1. Aphid (*Aphis craccivora*)

The aphid population count was taken on three leaves (from upper, medium and lower strata) per plant (Satpathy, 1973) on a total of ten randomly selected plants from each plot during a weekly period, shortly after the plant's emergence, till the harvest of the crop.

2. Thrips (*Scirtothrips dorsalis*)

The population of thrips was assessed by quantifying the number of thrips observed among unopened tender leaves (terminals) of ten tagged plants in each quadrat, use a 10X magnification lens.

Meteorological data

Meteorological data regarding temperature (minimum and maximum), relative humidity, rainfall, evaporation, wind velocity, and sunshine hours were obtained from the meteorological section of R. M. D. CARS, Ambikapur (C.G.).

Data analysis

The impact of abiotic factors (*viz.*, temp. (maximum and minimum), RH (morning and evening), rainfall, sunshine hours, and evaporation) on the population of the key insects pest of groundnut was analyzed using Pearson's correlation. Additionally, a regression equation was developed using SPSS (Version 20, SPSS, Inc. Chicago, 2, USA).

RESULTS AND DISCUSSION

1. Seasonal incidence of aphid (*Aphis craccivora*) in relation to weather parameters on groundnut during kharif 2022

The initial incidence of groundnut aphid per three compound leaves on the plant revealed that the first emergence of the pest incidence was reported during second week of August (32nd SMW) with (0.73 aphid three leaves/plant). The results showed that *Aphis craccivora* were consistently present at different densities and at different times and remained active throughout the growing season of groundnut. Population dynamics of *Aphis craccivora* found in the groundnut agro ecosystem during the experimental season, *i.e.*, kharif 2022, have been presented in table: 4.1 Its multiplication varies from 0.73 to 8.62 aphid three leaves/plant.

The population of aphid, *i.e.*, *A. craccivora*, first appeared on the crop during the 32nd Standard Week, which is the second week of August, with a mean population of 0.73 aphids per three leaves. During this period, the maximum and minimum temperature was 32.2 °C and 23.4 °C, the morning and evening relative humidity was 91.1 and 84.1 per cent, and the rainfall was 92.2 mm. Thereafter, the density of aphid increased gradually till the 36th SMW. The nymph and adult population of aphid was found maximum with 8.62 aphid three leaves/plant in first week of September (36th SMW) which was favored by maximum temperature and minimum temperature of

30.1°C and 23.2°C, with morning and evening relative humidity of 92.1% and 73.8% respectively, with rainfall of 47.8 mm. After that, there was a sudden decline in their population in the 37th SMW, which is the second week of September, with 29.6 °C and 22.7 °C maximum and minimum temperature respectively, and with morning and evening relative humidity of 94.1 and 77.4 per cent respectively.

Correlation studies on seasonal incidence of *Aphis craccivora* during kharif 2022

The degree of linear relationship between population of *A. craccivora* in groundnut with various weather parameters (Tmax: maximum temperature; Tmin: minimum temperature; RHmax: maximum relative humidity; RHmin: minimum relative humidity) is presented through correlation matrix (Table: 1).

A perusal of (table: 2) indicated that *A. craccivora* had non-significant positive correlations with maximum temperature ($r = 0.034$), and minimum relative humidity ($r = 0.198$), and non-significant and negative correlation with maximum relative humidity ($r = -0.153$) whereas a significantly positive correlation was observed with minimum temperature ($r = 0.482^*$) and significant negative correlation with rainfall ($r = -0.369^*$).

The data on the incidence of *A. craccivora* when subjected to linear regression analysis, the following equation was developed.

$$\text{Groundnut aphid} = 35.025 + 0.235 \text{ Temperature (maximum)} + 2.434 \text{ Temperature (minimum)} + 0.128 \text{ RH (morning)} - 0.428 \text{ RH (evening)} - 0.042 \text{ (Rainfall)} \quad (R^2 = 0.835)$$

The regression equation developed between the aphid population (*A. craccivora*) and other selected abiotic variables such as temperature (maximum and minimum), morning and evening relative humidity, and rainfall, all together, contribute around 83.5 per cent to the population of *A. craccivora* in groundnut respectively with reasonable accuracy ($R^2 = 0.835$) (Table: 2)

A perusal of Table: 1 depicted that with every 1 °C increase in maximum temperature and minimum temperature there was an increase of 0.235 and 2.434 numbers of aphids respectively and 1 percent increase in morning relative humidity there was an increase of 0.128 numbers of aphids. However there was a decrease of 0.428 and 0.042 numbers of aphids for every 1 percent rise in evening relative humidity and 1 mm rise in rainfall respectively.

The present results coincide with previous studies conducted by Yadav *et al.* (2007), Nayak *et al.* (2019), and Saritha *et al.* (2020). These studies reported that the incidence of aphid occurred between the fourth week of July and the second week of August, with the peak population observed from the first to fourth week of September. These findings corroborate the current findings. The observed differences in the start and peak timing of the incidence, as reported by the aforementioned studies, could perhaps be attributed to variations in

the agro-climatic conditions of the specific region and the timing of the sowing process.

The findings suggest that there is a notable positive relationship between aphid population and maximum temperature, indicating that as the temperature increases, the infestation increase gradually. The findings of the correlation analysis conducted on the relationship between the aphid population and several meteorological parameters revealed that there was no statistically significant link seen with maximum temperature and morning and evening relative humidity. This conclusion aligns with the observations made by Kataria and Kumar (2017), who found a statistically non-significant positive correlation between the presence of aphids and both maximum and minimum temperatures in bean crops. Rathode (2006) discovered similar results, finding a non-significant negative relationship between aphid population and other weather variables such as relative humidity (morning and evening). Kandakoor (2019) discovered a significant negative association between aphid population and rainfall. Gocher and Ahmad (2019) discovered a negative association between aphid population and maximum temperature in their investigation.

The results of the correlation analysis examining the relationship between aphid population and abiotic factors indicate that the pest population is not influenced by a single abiotic factor, but rather by multiple factors that contribute to the increase in aphid population during crop seasons. Additionally, it has been observed that temperature and humidity, when considered together, significantly impact the fluctuations in aphid population. These findings suggest that the population dynamics and growth of groundnut aphids are closely linked to weather conditions.

2. Seasonal incidence of thrips in relation to weather parameters on groundnut during the year 2022.

The seasonal incidence of thrips was researched on groundnut in accordance with the related meteorological parameters at RMD, CARS to evaluate the association between them during the *kharif* season of 2022. The data collected on the dynamics of thrips revealed that their population fluctuated from 32nd SMW to 42nd SMW, with population ranging from 0.20 to 4.80 thrips per top bud leaves (Table: 3 and 4). The 1st incidence of thrips was reported on 2nd week of August, with a mean population of 0.27 thrips/top bud leaves. During the initial infestation, the maximum and minimum temperatures were 32.2 °C and 23.4 °C, respectively, and the morning and evening relative humidity was 91.1 and 84.1 per cent, respectively. The amount of rainfall recorded was 92.2 mm.

The thrips population increased as crop growth progressed, and two closer peaks in the thrips population were seen. The first peak was recorded during the 35th SMW (first week of September) with a

mean of 4.06 thrips/top bud leaves. During that time, the maximum and minimum temperatures were 29.8 °C and 23.5 °C, respectively, with 88.1 and 75.8 per cent relative humidity in the morning and evening, respectively. While the rainfall was 53.4mm. Similarly, the second peak, with a mean of 4.80 thrips/top bud leaves, was attained on 36th standard week (second week of September). The average maximum and minimum temperatures were 30.1 °C and 23.2 °C, respectively, with 92.1 and 73.8 per cent relative humidity in the morning and evening hours and rainfall was 47.8 mm. Following that, the population began to decline, reaching its lowest level, i.e. 0.20 thrips/top bud leaves in the 42nd SMW (third week of October), when the average maximum and minimum temperatures prevailed were 30.1 °C and 17.5 °C, respectively, and the average morning and evening relative humidity were 88.7 and 60.5 per cent, respectively and rainfall was 18.8mm.

Correlation studies on population buildup of thrips with several weather parameters during 2022

The correlation coefficient (r' value) of the thrips population infesting groundnut with the major prevailing meteorological parameters was calculated and presented in Table: 4.6 for year 2022. According to the correlation coefficient of thrips population with different weather variables shown that the thrips population on groundnut unveiled a positive and significant relationship with minimum temperature ($r = 0.465^*$), and negative significant correlation with rainfall ($r = -0.326^*$). The thrips population, on the other hand, had a non-significant negative correlation with maximum temperature ($r = -0.057$) and morning relative humidity ($r = -0.082$). While there was a non-significant positive correlation with evening relative humidity ($r = 0.151$).

The data on the incidence of thrips when subjected to linear regression analysis, the following equation was developed.

The regression equation (Table:3) showed that the weather parameters *viz.*, temperature (maximum and minimum), morning and evening relative humidity, and rainfall, were found to contribute around 82.3 per cent to the population of thrips in groundnut when acted together with reasonable accuracy ($R^2 = 0.823$).

Groundnut thrips = 23.352 + 0.079 Temperature (maximum) + 1.565 Temperature (minimum) + 0.127 RH (morning) – 0.288 RH (evening) – 0.027 (Rainfall) ($R^2 = 0.823$)

The regression equation used to analyse the effect of weather parameters on groundnut thrips depicted that for every 1 °C increase in maximum temperature, minimum temperature and morning relative humidity, the number of thrips increased by 0.079, 1.565 and 0.127 respectively, while there would be a decrease of 0.288, and 0.027 numbers of thrips for

every 1 per cent rise in evening relative humidity, and 1 mm increase in rainfall, respectively.

This study consisted the observation and recording of thrips and their respective activities. The initial occurrence of their appearance was seen in the second week of August, with their peak activity being recorded during the subsequent week of September. Kandakooret *et al.* (2012) and Radhika (2013) both observed an increase in the population of thrips during the latter stages of the rainy season. There was a positive, non-significant correlation seen between the temperature (maximum) and the thrips population. Additionally, a non-significant negative association was found between the temperature (maximum) and the relative humidity (evening), while a positive correlation was observed between the temperature (maximum) and the highest relative humidity. The data suggested that the combination of temperature and relative humidity was conducive to the proliferation of the insect population. The findings align with the studies conducted by Ahir *et al.* (2017) and Kandakoor *et al.* (2012)

CONCLUSION

Aphid

Its reproduced from 0.73 to 8.62 aphid three leaves /plant. The population of aphid reached to its peak in 36th SMW (05 Sep.–11 Sep.) with 8.62 aphid three leaves /plant in first week of September. The correlation between aphid population and meteorological parameters. The population of aphids has a positive relationship with temperature maximum, temperature minimum, and relative humidity (morning) while there is a negative association between relative humidity (evening) and rainfall (mm). The correlation was significant with minimum temperature.

Thrips

Its multiplication varies from 0.27 to 4.80 thrips /top bud leaves. The insect population of thrips was found maximum with 4.80 thrips /top bud leaves in first week of September (36th SMW)

The thrips population exhibit positive correlation with minimum temperature and relative humidity (morning). While negative relationship with maximum temperature, relative humidity (evening) and rainfall. The correlation were significant with minimum temperature.

Table 1. The seasonal incidence of aphid on groundnut *khari*f crop during the year 2022

S.N.	Standard Meteorological Weeks	Date of observation	Mean aphid population/ 3 leaves	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
				Maximum	Minimum	Morning	Evening	
1.	32	08 Aug. - 14 Aug.	0.73	32.2	23.4	91.1	84.1	92.2
2.	33	15 Aug. - 21 Aug.	1.66	29.2	23.0	94.0	81.5	102.0
3.	34	22 Aug. - 28 Aug.	1.13	25.5	22.9	94.0	72.8	139.2
4.	35	29 Aug. - 04 Sep.	4.99	29.8	23.5	88.1	75.8	53.4
5.	36	05 Sep. - 11 Sep.	8.62	30.1	23.2	92.1	73.8	47.8
6.	37	12 Sep. - 18 Sep.	3.62	29.6	22.7	94.1	77.4	63.2
7.	38	19 Sep. - 25 Sep.	4.26	29.8	22.6	94.0	74.8	78.6
8.	39	26 Sep. - 02 Oct.	1.13	30.2	21.6	93.5	67.8	163.2
9.	40	03 Oct. - 09 Oct.	4.16	29.7	22.0	89.4	72.0	28.2
10.	41	10 Oct. - 16 Oct.	1.13	30.7	20.9	95.5	69.4	62.8
11.	42	17 Oct. - 23 Oct.	0.00	30.1	17.5	88.7	60.5	18.8

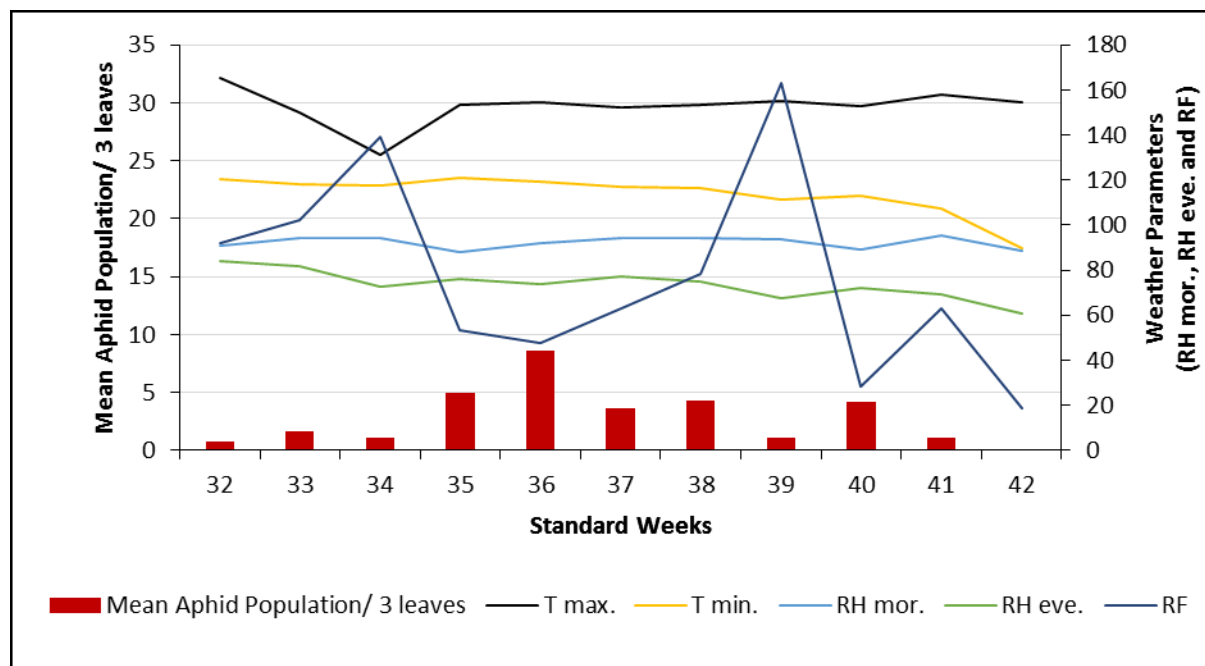


Fig 1. The seasonal incidence of aphid on groundnut crop during kharif 2022

Table 2. Correlation matrix (Pearson’s) for weather based observation with aphid population on groundnut during kharif 2022

Variables	Groundnut aphid	Maximum temperature	Minimum temperature	Relative humidity maximum	Relative humidity minimum
Maximum temperature	0.034 ^{NS}				
Minimum temperature	0.482 ^{**}	-0.119 ^{NS}			
Relative humidity maximum	-0.153 ^{NS}	-0.225 ^{NS}	0.220 ^{NS}		
Relative humidity minimum	0.198 ^{NS}	0.129 ^{NS}	0.847 ^{**}	0.186 ^{NS}	
Rainfall	-0.369 ^{**}	-0.341 ^{NS}	0.347 ^{NS}	0.554 ^{NS}	0.208 ^{NS}

Table 3. The seasonal incidence of thrips on groundnut kharif crop during the year 2022

S.N.	Standard Meteorological Weeks	Date of observation	Thrips/ top bud leaves	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
				Maximum	Minimum	Morning	Evening	
1.	32	08 Aug. - 14 Aug.	0.27	32.2	23.4	91.1	84.1	92.2
2.	33	15 Aug. - 21 Aug.	0.53	29.2	23.0	94.0	81.5	102.0
3.	34	22 Aug. - 28 Aug.	1.33	25.5	22.9	94.0	72.8	139.2
4.	35	29 Aug. - 04 Sep.	4.06	29.8	23.5	88.1	75.8	53.4
5.	36	05 Sep. - 11 Sep.	4.80	30.1	23.2	92.1	73.8	47.8
6.	37	12 Sep. - 18 Sep.	3.07	29.6	22.7	94.1	77.4	63.2
7.	38	19 Sep. - 25 Sep.	3.47	29.8	22.6	94.0	74.8	78.6
8.	39	26 Sep. - 02 Oct.	0.73	30.2	21.6	93.5	67.8	163.2
9.	40	03 Oct. - 09 Oct.	1.87	29.7	22.0	89.4	72.0	28.2
10.	41	10 Oct. - 16 Oct.	1.27	30.7	20.9	95.5	69.4	62.8
11.	42	17 Oct. - 23 Oct.	0.20	30.1	17.5	88.7	60.5	18.8

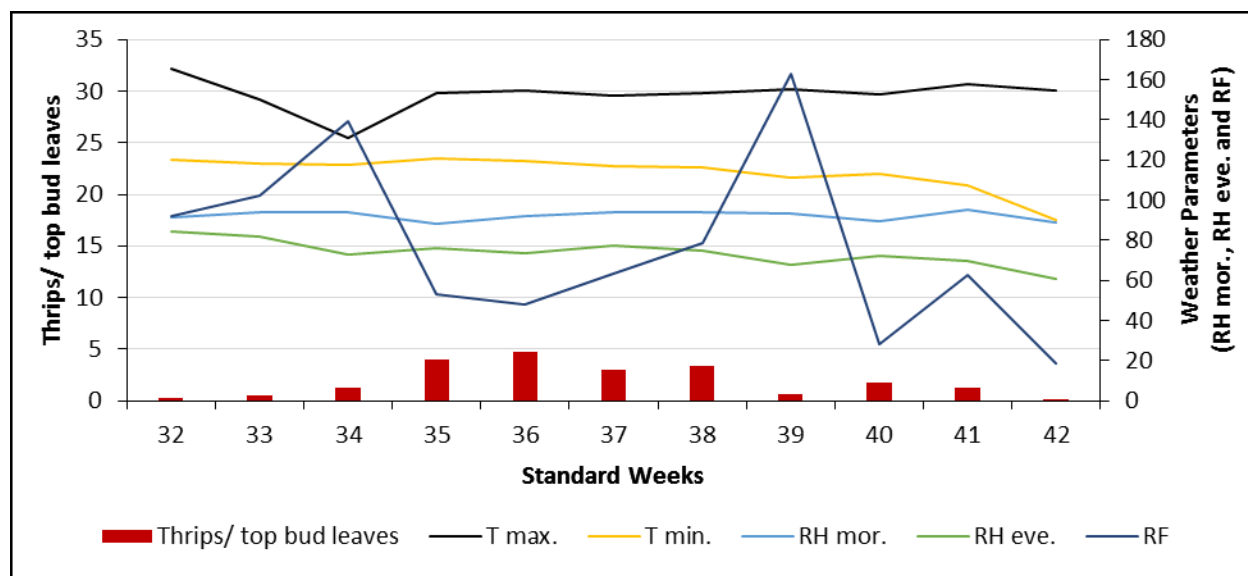


Fig 2: The seasonal incidence of thrips on groundnut crop during kharif 2022

Table 4. Correlation matrix (Pearson’s) for weather based observation with thrips population on groundnut during kharif 2022

Variables	Groundnut thrips	Maximum temperature	Minimum temperature	Relative humidity maximum	Relative humidity minimum
Maximum temperature	-0.057 ^{NS}				
Minimum temperature	0.465 ^{**}	-0.119 ^{NS}			
Relative humidity maximum	-0.082 ^{NS}	-0.225 ^{NS}	0.220 ^{NS}		
Relative humidity minimum	0.151 ^{NS}	0.129 ^{NS}	0.847 ^{**}	0.186 ^{NS}	
Rainfall	-0.326 ^{**}	-0.341 ^{NS}	0.347 ^{NS}	0.554 ^{NS}	0.208 ^{NS}

PLATE

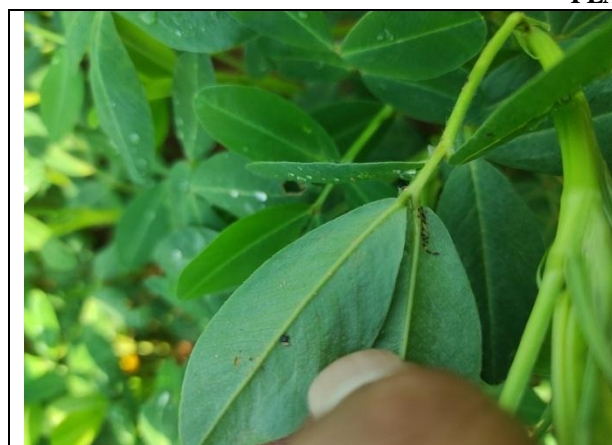


Plate: 1 Infestation of Aphid

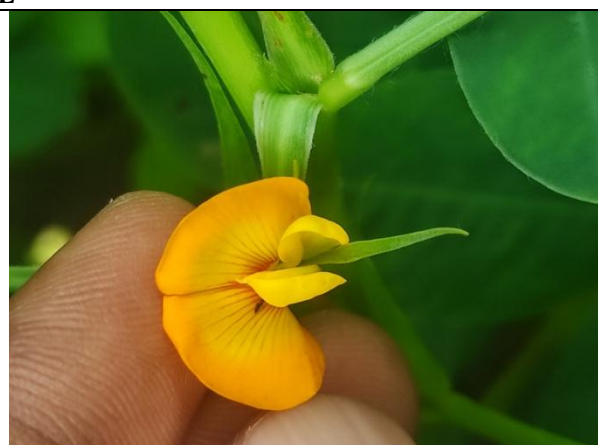


Plate: 2 Infestation of thrips

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